REMARKS

The Office Action mailed June 17, 2008 has been carefully considered. Reconsideration in view of the following remarks is respectfully requested.

Rejection(s) Under 35 U.S.C. §103(a)

Claims 1-3 stand rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Kaneko et al. (U.S. pat. no. 5,932,990, hereinafter, "Kaneko") and further in view of Baldwin et al. (U.S. pat. no. 6,583,603; hereinafter, "Baldwin"). Applicants respectfully traverse.

Claims 1 and 3 have been amended to state, for example according to claim 1, that the "lithium ion battery is always connected to said DC power supply apparatus or said load device." This feature is not shown or suggested by Kaneko or Baldwin, considered singularly or in combination.

In the Office Action, it is asserted that Kaneko teaches a DC power supplier (4); a load device (3); a lithium ion battery (1a-1n) for back up that is connected in parallel with said DC power supply apparatus and said load device (FIG. 1); a charging path; a switch (2) that disconnects said lithium ion battery from said load device, or connects said lithium ion battery to said load device (col.4, lines 38-40). It is also acknowledged that Kaneko does not explicitly teach a charging current limiting circuit that is connected in series with said lithium ion battery and supplies a charging current of an arbitrary value independent of load fluctuations in the charging path of the lithium ion battery; and control circuit that monitors the voltage value of said charging path, sets a reference voltage setting used for setting the charging current of an arbitrary value in said charging current limiting circuit, and controls said switch when said voltage of said charging path exceeds a specified voltage value during charging. According to the Office Action, however, Baldwin discloses the charging current limiting circuit and the control circuit, and

> it would have been obvious to one of ordinary skill in the art at the time the invention was made to have had the teachings of Baldwin in the device of Kaneko to have prevented the battery from receiving damaging excess recharge current levels and for isolating

> the batter from load and the primary power supply." (citations omitted)

It will be appreciated that Kaneko is intended for use in an assembled battery for cars and so it is for repeating charging the assembled battery and discharging the assembled battery to a motor. Accordingly, it is understood that during the assembled battery being charged, the switch (2) of Kaneko is open and only when the motor is driven is the switch (2) closed (connected). Therefore, claims 1 and 3 as now amended are not met by Kaneko. Also, the switch (2) of Kaneko is not connected to the control circuit, as shown by FIG. 1 of Kaneko. Accordingly, Kaneko cannot perform controlling of the switch (2) as performed in the present invention. Here, the present invention can control the switch (6), as described from line 21 of page 7 to line 1 of page 8 of the specification, wherein it is stated that

> the switch 6 is mainly used for circuit disconnection to protect the lithium ion battery 1, whereby the switch 6 becomes 'open' when the cell voltage rises to a voltage that is the rated voltage of the battery. Also, the switch 6 can be used for protecting the lithium ion battery 1 from over-discharging, whereby when the voltage of an arbitrary lithium ion battery 1 falls to a specified value during discharging, the switch 6 becomes 'open' to protect the lithium ion battery 1.

That is, Kaneko cannot protect the assembled battery from overcharging and over-discharging. On the other hand, in the present invention, since the switch (6) is connected to the control circuit (7), the switch "controls said switch when said voltage of said charging path exceeds a specified voltage value during charging (lines 16 to 17 of Claim 1)" and "switches said switch when said voltage of said charging path exceeds a specified voltage value during charging (lines 19 to 20 of Claim 3)".

Furthermore, the Office Action asserts that lines 42 to 51 of column 4 and lines 44 to 48 of column 10 of Baldwin teach the structure of the present invention in that "a control circuit that controls said switch when said voltage of said charging path exceeds a specified voltage value during charging." However, lines 42 to 51 of column 4 of Baldwin state that the assembled battery 14 is connected to or opened from a load 10 by switching ON or OFF a SCR28 in FIG. 2

in accordance with conditions. Also, Baldwin describes that switching ON or OFF of the SCR28 is beneficial for "proper maintenance of the battery strings (line 38 of column 4)." Baldwin further describes that "under normal operating conditions, the SCR28 is turned "OFF" (lines 39 to 40 of column 4)." Accordingly, it will appreciated that the limitation of claims 1 and 3 as currently amended are not disclosed in Baldwin.

Moreover, lines 44 to 48 of column 10 of Baldwin describe operating SCR28 by comparing the assembled battery system and a bus voltage during boost charging in FIG. 2. However, it is normal to perform a switching operation if there is a voltage difference between the DC system and the assembled battery system by the switch placed therebetween.

The Office Action further asserts that lines 3 to 10 of column 9 of Baldwin teach that

> a charging current limiting circuit that is connected in series with a battery and supplies a charging current of an arbitrary value independent of load fluctuations in the charging path of the lithium ion battery; and a control circuit that monitors the voltage value of said charging path, sets a reference voltage setting used for setting the charging current of an arbitrary value in said charging current limiting circuit (lines 3 to 10 of column 9), and controls said switch when said voltage of said charging path exceeds a specified voltage value during charging (lines 44 to 48 of column 10 and lines 42 to 51 of column 4).

However, lines 3 to 10 of column 9 merely describe a concept of setting the maximum output current of a rectifier (For example, refer to FIG. 3.3. of page 34, line 3 and thereafter of page 34, and line 22 of page 34 of attached copy of "Power Supply in Telecommunications 3rd Edition", Hans Gunmhalter, 1995). In a direct current power supply system like Baldwin, the maximum output current of the rectifier may be a value that is enough for a load current and charging of the assembled battery, whereby placing a rectifier provided with an output exceeding the output current value is good for "economizing" as described in line 5 of column 5 of Baldwin. Accordingly, Baldwin does not disclose "a charging current limiting circuit" or "control circuit" of the present invention and also Baldwin does not disclose the structural feature of the claims as currently amended.

Therefore, the claims of the present application include structural features which are not disclosed in Kaneko or Baldwin, such as, for example according to claim 1, “said lithium ion battery is always connected to said DC power supply apparatus or said load device. Advantages of this distinguishing feature include “uninterruptibility of system” which is required for a system for supplying power to communication devices and the like. Neither Kaneko nor Baldwin disclose this feature or realize this advantage.

Moreover, Applicants respectfully submit that the combination of Kaneko and Baldwin is improper. In lines 6 to 10 of column 9 of Baldwin, prevention of the battery strings 14 from receiving damaging excess recharge current levels is described. However, specific means for the prevention is unclear. Accordingly, when applying the structural feature of Baldwin into the apparatus of Kaneko, it is expected that the prevention of the battery strings from receiving damaging excess recharge current levels is impossible. The reason is that there are no elemental devices, which are disclosed in the present invention, such as a charging current control element 43 for uniformizing cell voltages and a bypass current limiting element 522 of a voltage regulation circuit disclosed in Kaneko or Baldwin. Accordingly, it is not possible to simply combine Kaneko and Baldwin.

Conclusion

In view of the preceding discussion, Applicants respectfully urge that the claims of the present application define patentable subject matter and should be passed to allowance.

If the Examiner believes that a telephone call would help advance prosecution of the present invention, the Examiner is kindly invited to call the undersigned attorney at the number below.

Please charge any additional required fees, including those necessary to obtain extensions of time to render timely the filing of the instant Amendment and/or Reply to Office Action, or credit any overpayment not otherwise credited, to our deposit account no. 50-1698.

Respectfully submitted,
THELEN LLP

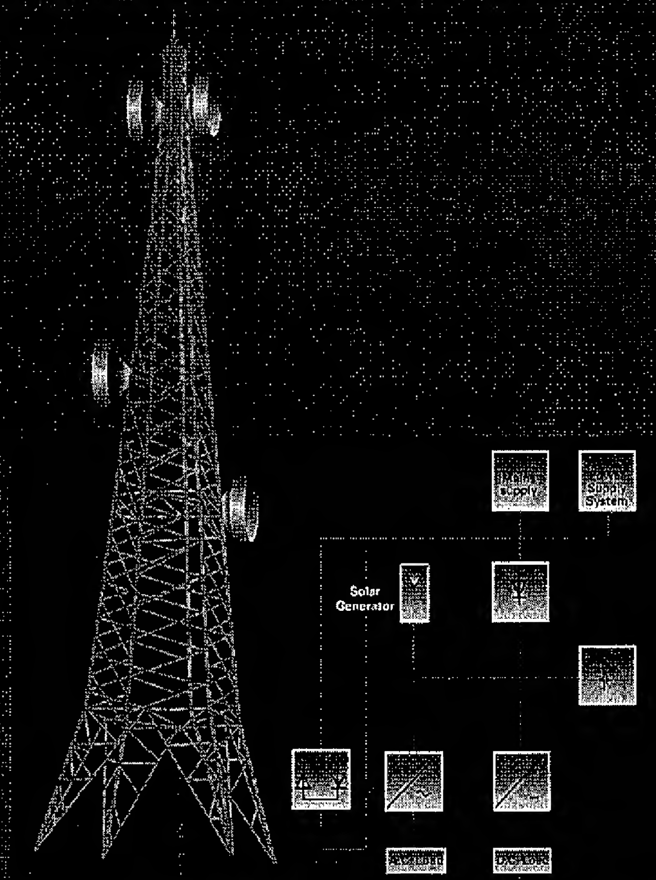
Dated: October 17, 2008

/Khaled Shami/
Khaled Shami
Reg. No. 38,745

THELEN LLP
P.O. Box 640640
San Jose, CA 95164-0640
Tel. (408) 292-5800
Fax. (408) 287-8040

Hans Gumhalter

Power Supply in Telecommunications



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Hans Gumhalter
Siemens AG
Hofmannstraße 51
D-81359 München
Germany

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This book is dedicated to the memory
of my dear late father

Felix Gumhalter,
born 6 January 1905
and deceased 30 December 1993,
Retired Post and Telegraph Superintendent,
Vienna, Austria.

I owe him everything in my life.
His works and his humanity will be
remembered by all who knew him.

Hans Gumhalter

3 Operating Modes of a Direct Current Power Supply System

Figure 3.1 gives an overview of the operating modes of d.c. power supply systems currently in application. Table 2.1 applies to the operating voltages of communications systems.

3.1 Rectifier Mode

In the rectifier mode, also called the direct feed mode, there is *no* battery. The communications system is supplied with direct voltage directly from the mains via the rectifier (Fig. 3.2). The supply is interrupted for the duration of any power failure or in the event of a breakdown of the rectifier. The rectifier automatically switches on again on return of the mains. This mode is used with small to medium-sized communications systems when occasional interruptions in operation can be accepted.

3.2 Battery (Charge-Discharge) Mode

Because of its relatively low efficiency and the especially large strain on the battery, this mode of operation is used in today's telecommunications power supply systems only when the mains supply fails and consequently the continued presence of a.c. power must be insured by a mains-independent power supply system. In a typical case, two emergency power generators of relatively short operating time charge the battery through rectifiers. The generators actually run for a few hours only, whereas the load is continuously supplied from the battery. The maintenance intervals for the generators can thus be lengthened.

The battery mode (not illustrated in Fig. 3.1) can also be used in solar-generating or wind-driven generating systems.

3.3 Standby Parallel Mode

If the communications system is required to provide continuous unrestricted service during a power failure, or in the case of other troubles, a reserve of energy (preferably in the form of a lead battery) should be kept ready. In the parallel mode the rectifier, battery and communications system are constantly connected in parallel (Fig. 3.3). If the rectifier fails, the battery takes over the further supply

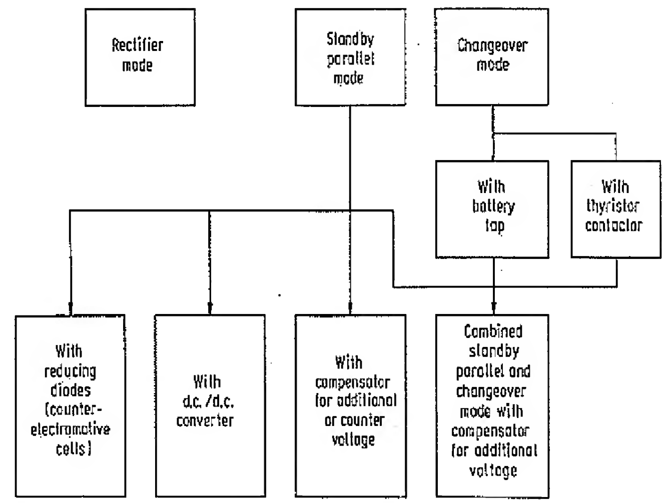

Fig. 3.1. Operating modes of d.c. power supply systems

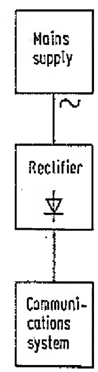

Fig. 3.2. Rectifier mode

of the communications system until the rectifier, e.g. on return of the mains, starts operating again. The rectifier then supplies the communications system again and also charges the battery.

In the parallel mode a distinction is made between the floating mode (not illustrated in Fig. 3.1) and the standby parallel mode. In the *floating mode* the

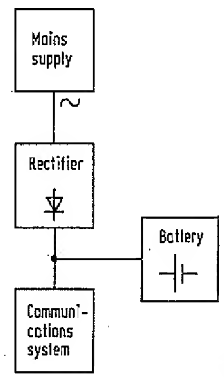

Fig. 3.3. Basic representation of the standby parallel mode

rectifier can handle the communications system's normal energy requirements, though it cannot deal with the peak current. In this case the battery provides the current over and above the rectifier's rated current ($I_{load} > I_{rated}$). If the energy requirement (outside busy hours) diminishes again, the battery takes up a charging or trickle charging current from the rectifier; in other words, the battery is either used as a supplementary power source or is being charged. In the floating mode it sometimes happens that the full battery capacity is not available. This means a shorter reserve time for bridging a power failure, unless a correspondingly larger battery capacity is chosen with regard to a certain reserve time. The life of the battery is shortened in the floating mode. That is why today the second variant of the parallel mode, viz. standby parallel mode, is generally chosen.

In the *standby parallel mode* the rectifier always covers the communications system's whole energy requirement. The battery is also supplied with a 'trickle (float) charge' by the rectifier. It is therefore available with its full capacity in case of a power failure or breakdown of the rectifier, provided the interval of time between the previous duty and renewed discharging has been sufficient to charge the battery.

In practice, for additional security, one more rectifier is provided ($n + 1$ redundancy) than is actually necessary to cover the power requirements of the load (Fig. 3.4) (Fail-safe d.c. power supply). This rectifier serves as reserve and battery-charging device (trickle (float) charging, recharging). If in exceptional cases the communications system requires a higher current than that rated for the rectifiers, this current is supplied by the battery.

To avoid the dependence on battery capacity and line length as regards filtering all rectifiers are smoothed and stabilized for the interference voltage values required by the communications system, regardless of the mode in which they are used (see Table 2.1).

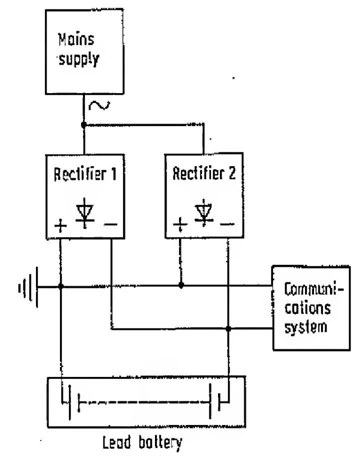

Fig. 3.4. Standby parallel mode

In present-day communications systems d.c./d.c converters and inverters whose permissible input voltage range is so great that they can be directly connected in parallel with the battery are increasingly used. Thus, the standby parallel mode can be used without further refinements for systems such as EWSD, since a wider operating voltage tolerance range is permissible here.

The advantages of the standby parallel mode are:

- a longer battery life due to continuous trickle charging;
- the full capacity of the battery and the calculated reserve time are available in the event of power failure or system outages as, in normal operation, it is always fully charged;
- uninterrupted supply of the communications systems with no additional switching devices;
- load surges are to a certain extent compensated for by the battery; thus the battery relieves the communications system of load surges, since it is continually connected in parallel.

Description of mode of operation. During normal operation (Fig. 3.5, operating state 1) – with mains operative – the rectifier supplies the communications system. The trickle (float) charge voltage of 2.23 V/cell is applied to the battery. The customary number of lead battery cells for 48 V and 60 V systems is listed in Table 3.1 (see also Table 2.1).

Thus the rectifier devices for example, a 25-cell lead battery, deliver a voltage of about 56 V (tolerance e.g. ±0.5%) and for a lead battery with, e.g., 30-cell a voltage of about 67 V (tolerance e.g. ±0.5%) to the communications system and the battery connected in parallel.

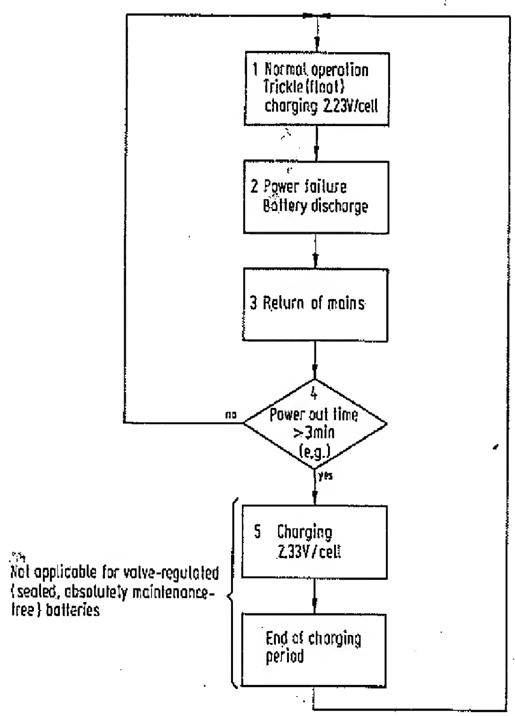

Fig. 3.5. Flow chart for standby parallel mode

Table 3.1. Number of lead battery cells

	48-V systems	60-V systems
Cells	24	30
	25	31

On power failure (Fig. 3.5, operating state 2) the battery is discharged. The voltage to the communications system corresponds to the battery voltage (less voltage drop). After a short time the rated battery voltage of 2 V per cell is reached.

On return of the mains (Fig. 3.5, operating state 3) it is checked how long the mains power was off. If the duration of the failure was less than the preset time (of e.g. 3 min), then all rectifiers switch back to normal operation (operating state 1).

If the mains failure lasted longer than the present time (of e.g. 3 min), then all rectifiers switch back on with higher voltage than normal (Fig. 3.5, operating state 5, charging with 2.33 V/cell).

The required charging voltage can be calculated as follows:

2.33 V multiply with number of cells.

After charging is completed (adjustable, according to system, e.g. up to 24 h) the rectifiers are switched back to normal operation (operating state 1).

There are also systems (e.g. rectifier modules) in which the duration of charging at 2.33 V/cell is made to depend on the duration of the mains failure:

Main fault duration in minutes:		Duration of charging at 2.33 V/cell in hours (setting options):
> 2	→	2
> 4	→	4
> 6	→	6
>10	→	10
>14	→	14
>18	→	18
>24	→	24

Remark: If the mains fault was smaller than <2 min …… < 24 minutes, after power return there is no charging 2.33 V/cell but 2.23 V/cell again. There is an automatic switch back from 2.33 V/cell to 2.23 V/cell after the adjusted charging time – of e.g. 2 h is over.

If valve-regulated (absolutely maintenance-free, sealed) batteries are used, there is no switchover to charging at 2.33 V/cell (blocking of the charging characteristic). In addition to the variants of the standby parallel mode shown in Fig. 3.1, this operating mode can also be used in conjunction with solar, wind and hybrid power supply systems.

3.3.1 Standby Parallel Mode with Reducing Diodes (Counter electromotive Cells)

If a certain number of battery cells is provided for a communications system according to its minimum permissible operating voltage, which is reached when the battery finishes discharging and below which it must not fall (system-conditioned final voltage $U_{s\,min}$), the resultant supply voltage can become too high for the communications system, if it is connected in parallel. This is especially true of conventional systems with their narrow tolerance ranges.

Description of mode of operation. In normal operation the rectifier supplies the communications system. The voltage for a trickle charge of 2.23 V/cell is applied to the battery (Fig. 3.6). As the resultant voltage (2.23 V × number of cells) is too high for the communications system, it is reduced to the desired value by reducing diodes (counter electromotive cells). For this, the voltage drop (in the forward direction) of silicon diodes is used. The bridging contact K13 is